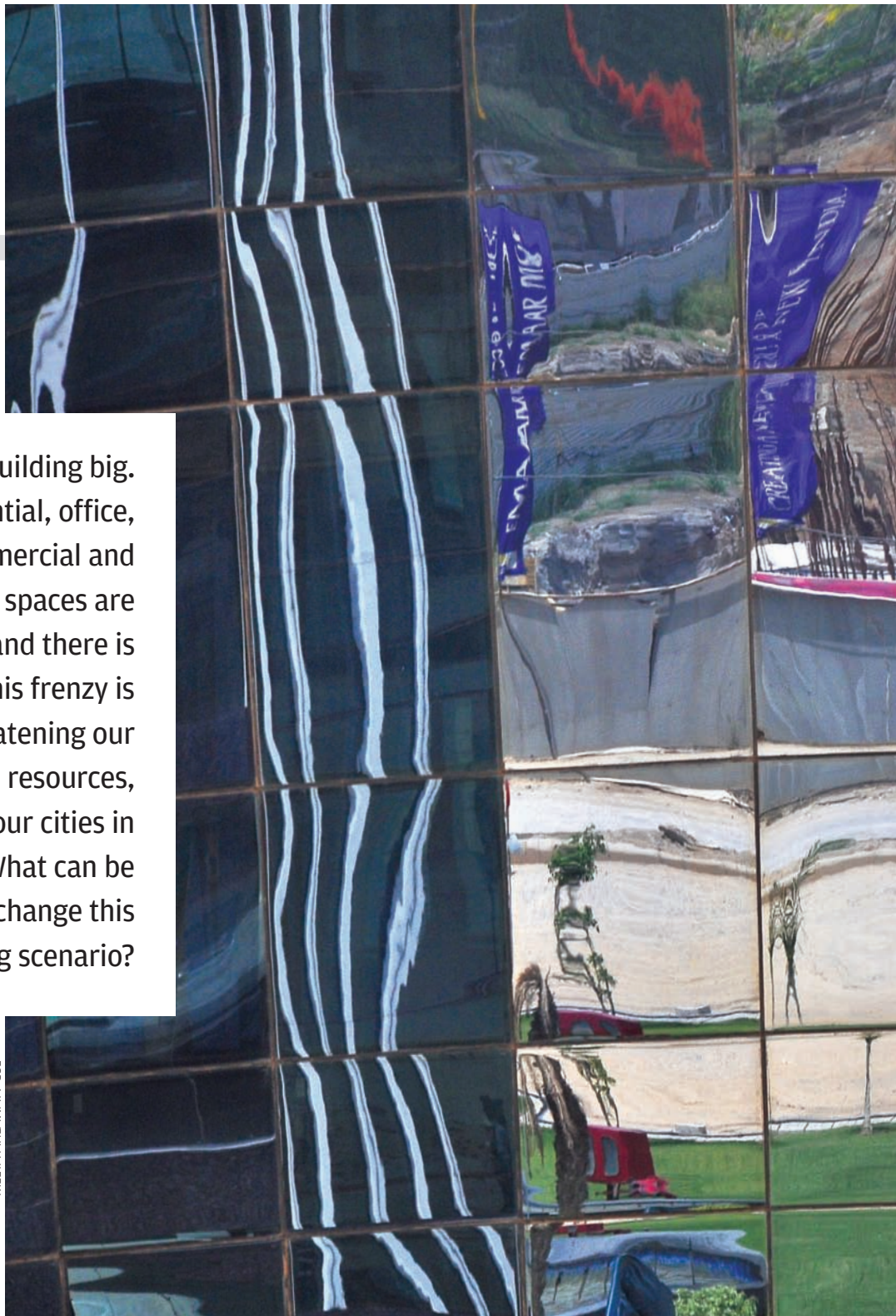
1 Why green buildings?



India is building big. Residential, office, commercial and retail spaces are mushrooming, and there is more to come. This frenzy is already threatening our environment and resources, and drowning our cities in their own waste. What can be done to change this frightening scenario?

MEETA AHLAWAT / CSE

AVIKAL SOMVANSHI / CSE

India has plunged into frenetic construction of buildings. There is a clamour for residential, office, commercial and retail spaces. If anyone thinks cities are already built to the brim, be warned. It is said that more than 60 per cent of buildings – our homes, offices and shops – that will stand in India in 2030 are yet to be built. This is an opposite trend to that in the Western world, which has already built 70-80 per cent of its future building stock. The scale of change in India is expected to be very big. Rapidly changing lifestyles and comfort will shape future buildings and lead to untamed resource guzzling. Cities will splurge precious water and energy and drown in their own waste. But it is possible to change that trajectory.

So far, urban poverty and traditionally frugal lifestyles have maintained very low-energy urban homes in India; but this will change. The 2010 study on urban infrastructure by the global consultancy firm McKinsey & Co estimates that the middle class will be the most dominant income group: it will account for half of all urban households by 2025. Its bullish buying power and consumption-driven lifestyle will redefine the code of comfort and building design, and will propel a massive jump in resource use. A 2014 study by the Global Building Performance Network and the Ahmedabad-based CEPT University predicts that the annual electricity use per household will grow four-fold, from 650 kiloWatt-hour (kWh) in 2012 to 2,750 kWh by 2050.

The challenge is to set the sustainability terms of this change.

THE SCALE OF THE CHANGE

It is not easy to quantify the scale of this change in India, as the official database on the building construction sector is very weak. What exists is also fragmented

across departments. The ministry of housing and poverty alleviation (MoHUPA) tracks the demand for housing units, but not the other built areas. The Planning Commission and other concerned departments assess the trends in the overall construction sector. But construction industry is omnibus and includes all infrastructure construction – industry, mining, roads and highways, power, irrigation, etc. Buildings are a part of it. Though the income tax, land revenue, urban development and the environment and forestry departments have records of all who have applied for approval for building projects, this data is not centrally compiled in a composite data bank.

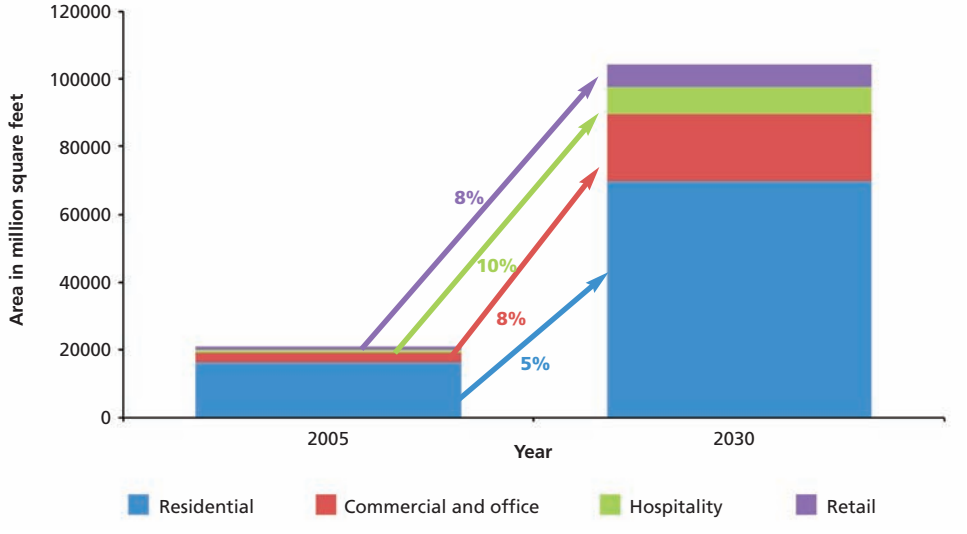
Therefore, limited sets of estimates from the real estate industry and associations like the Indian Green Building Council, Confederation of Real Estate Developers Associations of India (CREDAI), investment banks, and research institutions are the principal sources of information for this sector. These databases are often not comparable or publicly available. It is quite an opaque industry. However, a rough jigsaw of publicly available data points to some trends in built-up spaces in the country.

The trend reflects the real estate boom. According to Environmental Design Solutions Pvt Ltd (EDS), a New Delhi-based consultancy agency, the overall constructed area in 2005 was close to 2 billion square metre (sq m). This is a mere 20 per cent of the approximately 10 billion sq m that will be built in future, by 2030 – a five-fold increase. A sustained compound annual growth rate (CAGR) between 5 to 10 per cent is expected to be achieved during this period across different building types (see Graph 1: *Explosive increase in built-up area*).

India has emerged as the world's third largest construction business centre after China and the US. The 12th Five Year Plan forecasts an investment of as much as 10 per cent of the GDP, or Rs 45 trillion, in infrastructure. Mumbai-based construction industry expert Amit Rampure explains that every one rupee worth

GRAPH 1: EXPLOSIVE INCREASE IN BUILT-UP AREA

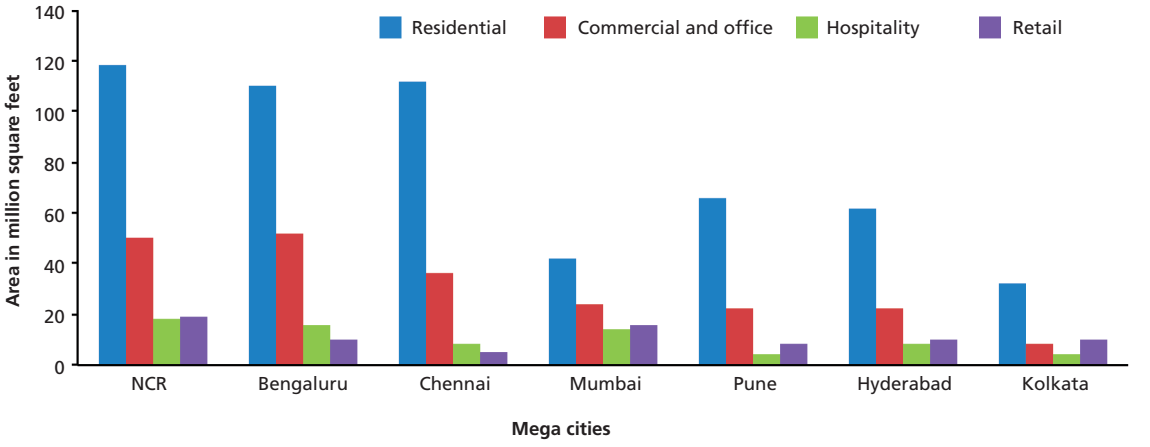
India is already the world's third largest centre for the construction sector



Source: Environmental Design Solutions Pvt Ltd

GRAPH 2: MEGA CITIES, MEGA GROWTH

Cumulative real estate demand up to 2012 by sectors: the growth will be in the megapolises



Source: Cushman and Wakefield

In India, private integrated townships covering an area of 40 to over 400 hectare (ha) each, and more than 200 townships covering over 81,000 ha are under approval

investment in the construction industry for manufacturing cement or for mining sand causes a Rs 0.80 increment in the GDP, as against Rs 0.20 and Rs 0.14 investment in agriculture or manufacturing industry, respectively. Despite a worldwide economic slowdown, the construction sector in India has grown by over 7 per cent between 2009 and 2010.

The big cities are the major destination points for real estate. The hotspots are Bengaluru, the National Capital Region of Delhi (NCR), Mumbai, Chennai, Hyderabad, Kolkata and Pune (see Graph 2: *Mega cities, mega growth*). In these mega cities, the commercial space will expand significantly. The states that have recorded maximum urbanisation rate (in the range of 50-30 per cent) include Maharashtra, Delhi-NCR, Tamil Nadu and Gujarat – these states have also recorded the highest number of projects.

TOWN-BUILDING MANIA

This is also about the new game of town building, adding to the construction boom. The Union budget for the year 2014-15 presented by the new government in India has promised 100 new smart cities. The Infrastructure Development Finance Company Ltd's (IDFC's) *India Infrastructure Report 2009* foreshadows the scale of this change. Private 'integrated' townships covering an area of 40 to over 400 hectare (ha) each, and more than 200 townships covering over 81,000 ha are under approval for planning and construction, especially around the four metros. Several private towns and cities are on the cards on the Delhi-Mumbai Industrial Corridor. A similar trend can be seen along highways like the Delhi-Jaipur corridor, or around Kolkata. But these new towns are sprouting without clear green benchmarks or master plans with sustainability norms and implementation strategies.

More than 50 to 95 per cent of the new buildings are expected to come up in resource-stressed suburbs and hinterlands as new townships. These townships are massive investment magnets. The real estate consultancy and research firm, Jones Lang LaSalle (JLL), reports that since 2006, international investors have put in

about US $15.8 billion into this sector. Of this, US $2.7 billion went to residential projects and US $2.4 billion to township projects, which is the second highest investment among all types of projects. The rest have gone into commercial, SEZ projects and others. Some states like Maharashtra are encouraging such towns with sops to developers including bypassing the urban land ceiling restrictions, non-agriculture tax conditional to the provision of 10 per cent affordable houses in these projects, automatic non-agricultural permission, concessions in stamp duty and development charges, a floating floor space index, and land given by state governments for contiguous projects.

This has started a worrying trend in which urban forms are getting pushed towards sprawl, segregated land use, and gated community structures that breed enormous resource inefficiencies and car dependency, and undermine the benefits of compact and mixed use urban design that was the inherent advantage of Indian cities. The new generation governance structures, policies and urban design norms have not kept pace with what is needed to shape new developments.

CLAMOUR FOR HOMES

The prolific construction has been dominated by a demand for residential units. There are several estimates of the housing deficit depending on the income category. A few years ago, the MoHUPA had broadly estimated the housing deficit at 26 million residential units. Subsequently, this has been revised to 18 million units. Nonetheless, demand for homes is expected to be explosive. One 2010 estimate from McKinsey & Co for low cost housing says it is expected to increase from 25 million units in 2007 to 38 million affordable housing units by 2030.

The housing policies of the government will be able to meet a very small fraction of this demand. Under the National Housing and Habitat Policy, 1998 and 2006, the government is expected to build two million dwelling units a year. Under the Jawaharlal Nehru Urban Renewal Mission (JNNURM) a much smaller target of one million units was set during the 11th Five Year Plan. On the whole, the government can address just about one per cent of the housing shortage. A much greater part of housing construction will happen in the private sector and through self-construction. This sector will make enormous demands on resources, as a substantial part of the residential sector will face lifestyle impacts.

The government, it is estimated, will be able to meet only one per cent of the housing demand in India. Self-construction and private sector will take the larger share

HOMES FOR THE POOR

Housing for the urban poor presents a special challenge. Urban poverty has hardened at a quarter of the population in cities. About 75 per cent of the urban poor are in the bottom rung of the income level. The Technical Group on Urban Housing Shortage (2012-17) constituted by the MoHUPA has estimated that about 95 per cent of the housing shortage pertains to the economically weaker sections and low income groups. Formal provisioning of housing, either by the government or the private sector, has not been able to meet the shortfall. In cities with more than a million people, nearly 40 per cent of the households lives in self-constructed settlements. Regulatory interventions are needed to augment housing stock for the poor by setting terms and norms for developers and new development. It will also require support for innovative housing design as well as technical support to poor households to improve comfort and liveability, built around resource efficiency, community facilities and thermal comfort features.

TABLE 1: ESTIMATED PAN-INDIA REAL ESTATE DEMAND (AREA IN MILLION SQ M)
The demand for residential spaces dominates

Year	Residential	Commercial	Retail	Hospitality
2009	12.3	4.4	1.7	1.3
2010	12.6	4.5	1.8	1.3
2011	13.2	4.7	1.9	1.4
2012	14.1	5	2	1.5
Total	**52.1**	**18.5**	**7.4**	**5.5**

Source: Anon 2008, *The metamorphosis: changing dynamics of Indian realty sector,* Cushman & Wakefield

COMMERCIAL BUILDINGS

The commercial spaces – hospitality, offices and retail – that show high growth rate, threaten to upset the resource budget in cities. These are expected to be very resource-intensive. McKinsey estimates that from the built-up area of one billion sq m in 2009, commercial spaces will grow to four billion sq m in 2030 – a four-fold increase. Hospitality and retail, which have had a relatively smaller constructed area so far, shall achieve a higher CAGR in the range of 8-10 per cent; by 2030, they will be seven to 11 times what they were in 2005. The Bureau of Energy Efficiency (BEE) estimates that the office stock would need to increase by nearly 2 million sq m a year in New Delhi, Mumbai and Bengaluru to keep pace with the demand.

Almost 80 per cent of the projected demand is expected to be in seven major cities, including Delhi-NCR

The projected demand by usage in the real estate sector shows varying trends (see Table 1: *Estimated pan-India real estate demand*). Among the built-up spaces, the demand for residential space would dominate at 63 per cent. The aggregate shares of office and retail would be comparatively smaller. The growth rate will be very high in the commercial component. But this component will also influence resource consumption the most. It has been noted in the US that with the increase in commercial spaces, energy intensity increased from an average 310 kWh/sq m/year in 1995 to an average of 351 kWh/sq m/year in 2003 – a 15 per cent increase – mainly due to higher levels of lighting and equipment used in commercial spaces.

RETAIL FRENZY

High-end retail will influence the construction sector considerably. According to the real estate consultant Cushman & Wakefield, India is ranked number two in the *Global Retail Development Index 2008*. This indicates that high-end construction activities are expected to escalate in India. The share of organised retail valued at US $30 billion in 2010, as per the estimates of Ernst & Young, will gain in prominence. NCR will hog 20 per cent of the future demand and Mumbai, about 16 per cent. In the 15 largest cities of India, 7.3 million sq m of space in 257 centers is expected to come up as sites for shopping malls. But malls without a leash can maul cities.

Cushman & Wakefield says that almost 80 per cent of the projected demand will be in seven major cities in India – NCR, Bengaluru, Mumbai, Pune, Hyderabad, Chennai and Kolkata. The NCR will witness such gregarious growth largely because of the emergence of business districts like Gurgaon and Noida and

concentration of corporate firms. Pune is expected to be the third fastest growing city and Mumbai the fourth. Besides, other cities like Jaipur, Ahmedabad, Kochi and Goa too will add a significant share to the total demand due to their governments' initiatives to promote tourism. Clearly, this will require stringent regulatory terms to minimise impacts.

WHO WILL BUILD AND SHARE RESPONSIBILITY?

The relative roles of the government and the private sector in building construction will change rapidly. So far, the government has been the key provider of housing in the residential category for different income groups – economically weaker sections and the low, middle and high income group. Many state governments have focused on providing housing for all income categories. But in future, the government will concentrate more on economically weaker and lower income groups.

The role of private players will grow steadily and rapidly in both residential as well as the commercial building sectors (including hospitality, offices and retail). For example, CREDAI (Confederation of Real Estate Developers' Association of India) has a 3,000-strong membership which is responsible for 80 per cent of the real estate development in 13 key states of India. These players will largely determine the technology and architectural pathways of the middle income and high income houses and commercial establishments in the country.

This will require regulatory interventions in terms of sustainability criteria, appropriate building bye-laws, and energy and resource efficiency codes. This is needed to link new investments in the sector with corporate social responsibility and strong regulatory supervision.

Till now, the government has been the key provider of housing for different income groups. In future, it will concentrate more on the poorer groups

GREEN WORRIES

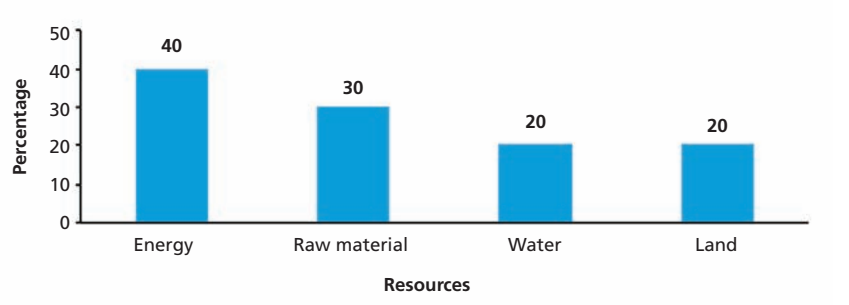
The construction boom has triggered environmental concerns: where and how buildings are built and used, decides their damaging impacts on environment. The lifestyle of the building occupier, the aspired comfort level, architecture and location, and the material used for construction exert impacts on energy, water, land, biodiversity, air, waste and traffic.

It is not easy to quantify the environmental impacts of the sector comprehensively. Limited studies have shown that in India, buildings are responsible for 40 per cent of the energy use, 30 per cent of the raw material use, 20 per cent of water use, and 20 per cent of land use. At the same time, they cause 40 per cent of the carbon emissions, 30 per cent of solid waste generation, and 20 per cent of water effluents (see Graphs 3A: *Burden of built environment* and 3B: *Share of built environment in pollution emission*). Buildings not only make enormous demands on natural resources; their maintenance, repair and demolition create huge amounts of waste and debris that can destroy waterbodies, open spaces and vegetation.

Globally, building construction and occupation have come under the spotlight for its very strong linkages with energy use and climate impacts. The *World Energy Outlook 2009*, the global energy usage tracker of the Paris-based International Energy Agency, says that half of the world's population in cities is already consuming two-thirds of the world's energy. By 2030, cities will be consuming 73 per cent of the world's energy. Likewise, globally, cities account for 70 per cent of

GRAPH 3A: BURDEN OF BUILT ENVIRONMENT

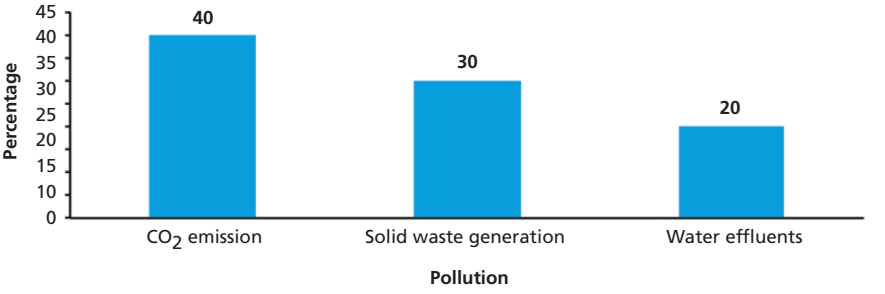
Buildings make enormous demands on natural resources...



Source: Environmental Design Solutions Pvt Ltd

GRAPH 3B: SHARE OF BUILT ENVIRONMENT IN POLLUTION EMISSION

... and lead to considerable pollution



Source: Anon 2008, *Green buildings – an overview, Capacity Building Series (2008-2009)*, June 2009, TARA Nirman Kendra, New Delhi

Energy consumption by the building sector increased from 14 per cent in 1970 to 33 per cent in 2004-05

CO_2 emissions. The tracker projects a big increase in global CO_2 from the increase in floor space in buildings of various types, especially in the non-OECD (Organization for Economic Cooperation and Development) countries due to lifestyle changes. Within the climate and energy debate, the urban consumption pattern in building units in cities thus becomes the focal point of mitigation.

In India, building construction and usage consumes one-third of the primary electricity. The National Habitat Standard Mission states that building energy consumption has increased from a low of 14 per cent in 1970 to 33 per cent in 2004-05. Climatic conditions have a strong bearing on the use of energy in buildings.

According to a 2011 study by the Alliance for an Energy Efficient Economy (AEEE) and an association of the energy industry, the increase in commercial building stock is pushing electricity consumption of the sector which is growing rapidly at 11-12 per cent annually. Between 1990 and 2005, commercial building energy consumption has increased by 60 per cent. The study further states that 580 special economic zones that have been approved, are expected to cover 1.1 billion sq m by 2030. This will drive the demand for energy-intensive air-conditioned space, as about 60 per cent of the commercial space in India will be air-conditioned; as per Mckinsey's 2009 estimates, four out of every 10 urban

homes will have at least one air-conditioner.

Studies have also begun to appear on the potential greenhouse gas savings from energy efficiency improvements in the building sector in India. A 2010 McKinsey estimate shows that the national power demand can be reduced by as much as 25 per cent by 2030, by improving energy efficiency of buildings and operations. With improved and optimised insulation and high-efficiency electrical appliances, energy consumption can be reduced by 55 per cent – this can cut down 150 million tonne (MT) of CO_2 emissions by 2030.

Water impacts of buildings are also very severe. All stages of construction, starting from the foundation, brick soaking, masonry, curing, concreting and whitewashing, to the laying of roofs and flooring involve intensive use of water. The water demand is generally 10 to 20 per cent of the total volume of brick and concrete used in a building. But with modification of techniques, water use can be minimised. Water-intensive phases such as curing and mixing of concrete can adopt more water saving techniques.

Generally, water demand is 10-20 per cent of the total volume of brick and concrete used in a building. But it is possible to minimise water use

Broadly, toilets and bathrooms with flushes, taps and showers devour more than 70-80 per cent of the total water used in a house. Less than 10 per cent of the total water in a household is used for drinking and cooking. Recycle and reuse of wastewater is the mantra: buildings should capture and reuse grey water from bathroom taps, showers and baths, washing machines and kitchen facilities; black water from the toilets; and storm water or the roof run-offs from impervious surfaces and drainage systems.

Water efficiency standards for water appliances and the right pricing signals can help reduce water usage. Just by improving the water efficiency of water fixtures, water demand can be reduced by more than 30 per cent. Several water uses like waterscapes, fountains etc may be discontinued or reduced when water is in severe shortage. The desperation today is to reduce per capita water usage in buildings without compromising on the essential hygiene standards. At present, 135 lpcd (litre per capita per day) is considered a standard guideline in India, prescribed by the Central Public Health and Environmental Engineering Organisation. Other governments are further reducing this. In the UK, for instance, 80-100 lpcd is seen as the desirable target in residential buildings.

Careful assessment of water availability – both groundwater and surface water – is essential for siting of buildings. This aspect is often compromised in the clamour for land and real estate. This can have serious impacts on the long-term sustainability of the area. This is starkly evident in Gurgaon, the rapidly growing residential and commercial town in Haryana near Delhi. Prolific construction in this water-stressed zone has led to a serious water crisis for the local residents, to the extent that the Punjab and Haryana High Court has put a moratorium on the use of fresh water for construction in the area.

The impact of building construction and operations on urban environment is intense and complex. The effect on energy, water, waste, air quality and traffic can be drastic if not modified with regulatory discipline. The large commercial buildings, especially the mega shopping malls, induce and attract huge amount of traffic on their access roads; this can have serious detrimental impacts on the surrounding neighbourhoods and also contribute to local air pollution and congestion. This has already resulted in tension and conflicts.

This concern has got even more pronounced in new towns sprouting around

mega cities and on important highway corridors. These urban forms are increasingly taking the shape of sprawls enabled by a car. This means even if a building is designed for energy efficiency, its occupants are forced by urban design to become more car-centric and therefore, more energy-intensive. This also needs mitigation.

Cities face the challenge of providing higher levels of comforts to people in resource-efficient ways. More integrated regulatory interventions are needed to reduce the adverse impacts of this sector.

SETTING THE POLICY PRINCIPLES RIGHT

The regulatory challenge is to set the terms of building construction and design as well as urban design and building operations, to prevent a lock-in of high resource intensity. Two sets of regulations have a bearing on resource efficiency – those directed at building construction and design and those that influence lifestyle choices and behaviour of users. Regulations are taking shape in India to ensure that buildings are constructed to, at least, lower the threshold level of water and energy requirements and minimise waste while improving comfort levels.

India has an architectural tradition that integrates sustainability principles, understands the wisdom of optimising the use of daylight and natural ventilation, all according to the demands of local climate

Setting the green terms for construction and operations of buildings is a very new area of governance in India. This presents a challenge of crafting appropriate regulations, codes for defining efficiency levels of energy and water use, waste minimisation, good monitoring and compliance strategies and impact analysis. The existing institutional mechanism will have to be reformed to carry out these functions.

India has a great architectural tradition that has integrated sustainability principles, understood the wisdom of optimising the use of sun and daylight, wind and natural ventilation, space design and a range of architectural features for improving thermal comfort according to local climate. Buildings in all ecosystems reflect diverse approaches that have lent identity to the traditional building stocks. This is changing dramatically now as modern technologies allow powerful interventions to mechanically alter and control thermal conditions in buildings, isolated from the local climatic advantages. This is making new building stock more energy- and resource-intensive.

The new technology choices and architectural and space design will be largely decided and dictated by the real estate industry. This developer-led modern mass construction of buildings will need strong regulatory oversight, guidelines and impact assessment to promote sustainable building practices.

Greening of the building sector requires interventions to reduce water and energy footprints, minimise waste and improve access to reduce dependence on energy-intensive transportation systems. It is a challenge to bring all these interventions under one unified regulation. This, therefore, demands more robust and harmonised action in all these sectors and a more integrated institutional mechanism for enforcement. The sector needs more result-oriented policies. The complexity of rules and norms related to resource use and management and regulatory structure to meet policy goals also makes enforcement more challenging. This is often not within the skills and capacity of the existing institutions.

The nascent beginning of regulations in this sector has, thus, thrown up several

challenges that will have to be understood and addressed urgently to avoid unintended consequences. The devil lies in the detail of the regulations. It is, therefore, important to review the existing legal framework that has a bearing on resource use and waste management in the building sector – including the affordable housing sector – to identify gaps and areas of reform.

EIA OF BUILDINGS AND TOWNS

Currently, the only explicit legal instrument that exists to assess and remedy environmental impact of buildings and townships is environment impact assessment (EIA), notified under the Environment Protection Act, 1986, one of the most powerful environmental legislations in the country. This is a mandatory and a legally binding instrument for greening of the building sector. EIA is mandatory for all new townships larger than 50 ha and for large buildings with a minimum area of 20,000 sq m. In other words, it targets the high-end large buildings that are expected to use a lot of resources.

Though this legal instrument is an opportunity to assess buildings holistically and from all aspects of resource use, the review of the system has exposed several institutional, technical and implementational glitches. This gives a lesson in framing new generation regulations and green norms for buildings and towns. EIA is administered by the MoEF, which has set up technical committees to review and approve projects at the Central and state levels. Given its challenges, there have been several attempts to amend the EIA process for buildings.

Environment impact assessment is mandatory for all new townships larger than 50 hectare, and large buildings with a minimum area of 20,000 sq m

There are many procedural, administrative and technical challenges associated with it. It undermines the quality and technical rigour of project approval. It is further compromised because of alleged corrupt practices. For instance, there is a tendency to avoid an EIA by under-reporting the area of the project, or starting building construction before getting the approval and consent from the concerned authorities, or very poor post-construction monitoring and compliance. Often, the technical committees set up at the state level are burdened with staggering numbers of projects to be cleared within a short time-span – they may not be well-equipped with the requisite skills, information and time to assess technical dimensions related to energy, water and waste paradigms of the building.

These gaps and flaws will have to be plugged and addressed if this system continues. An inefficient and corrupt system can erode confidence in the regulation and worsen compliance.

However, beyond these immediate issues of procedural reforms there are larger questions about the appropriate way of making this system work effectively. It is now being questioned whether this practice should be discontinued and be replaced with a system linked with the overall building design clearance, approval and completion certification process of urban local bodies in cities for single window clearance, but harmonised with the requisite benchmarks for energy, water efficiency and waste minimisation.

The urban planning community is also raising a larger concern over the merit of doing impact assessment of large numbers of individual buildings isolated from larger urban planning. There are questions about the merit of continuing with the EIA for individual buildings that add enormously to the burden of approval and duplicates what the urban local bodies are expected to do for building clearance and approval in any case. Should EIA be integrated with the building approval

process of municipal agencies and urban planning in cities to minimise bottlenecks and duplication and to get better results?

Industry, of course, does not like the EIA process because it is cumbersome and time consuming, and its compliance adds to the cost of the project. Industry and several other client agencies argue that urban local bodies must approve and also give completion certificates to all building projects – small or big – as per the local municipal bye-laws which are largely based on the National Building Code. The EIA process can also be integrated with this. Completion certificates can be given based on the compliance of environmental clearance.

There are other concerns as well. Several experts in the social sector have also criticised the way the powers have been granted to committees set up by environment departments under the Environment Protection Act to decide about buildings, when such decisions are expected to be taken by constitutionally empowered local bodies such as municipalities. Building clearance is a task for municipal corporations. It is, therefore, proposed that the municipal system should be reformed and customised to meet the needs of EIA. Instead of the technical committees getting into the micro-details of the buildings, urban local bodies can carry out the assessment within the larger provisions of building bye-laws. The municipal approval process should take care of the details related to the energy, water, and waste aspects of the buildings as per the bye-laws and other relevant laws of the land. The environmental clearance committees thereafter should only be focusing on macro-environmental impacts of the projects.

Building clearance is a task for municipal bodies. It is, therefore, proposed that the municipal system should be reformed and customised to meet the needs of EIA

It is also important to note that the building clearance process cannot remain isolated from the city master plans that pre-determine land use and earmark residential, retail and commercial developments or mixed use areas, that are also expected to reflect the carrying capacity of locations. If this is linked with the building clearance system of urban local bodies, then the decision on appropriateness of siting of large buildings can be addressed more cohesively. In this case, the committees – instead of carrying out their own assessments – can follow a due diligence to ensure that the proposed building has obtained all the requisite clearances from urban local bodies and state-designated agencies for different resource use and waste management. But Indian cities have a very poor record of preparing master plans and revising them. The existing ones are outdated and its provisions are violated.

This debate is at the crossroads and the jury is still not out on this. Those in favour of EIA for buildings hold that the normal practice of building approval and clearance that is carried out locally by urban local bodies, is too weak and limited to enforcing minimum standards and voluntary guidelines for all buildings. It does not have additional filters and appropriate standards and norms to screen and assess large resource-intensive buildings to minimise environmental impacts.

There are concerns that today's urban local bodies are not equipped to carry out assessments needed for technically complex clearance systems for green buildings. Building bye-laws and the National Building Code are implemented by urban local bodies and state development authorities. But for a great part – other than structural safety – the norms are voluntary and are geared towards meeting the minimum comfort requirements, not sustainability requirements. These bye-laws apply to all buildings irrespective of their size and resource use. But the large buildings that are the target of EIA regulations are the high-end resource guzzlers

that require the most stringent measures. The minimum requirements for all buildings will not suffice. This demands a separate system under urban local bodies or the relevant institutions for non-municipal areas that would make impact assessment more rigorous.

The advantage of the current EIA process is that it is carried out under the Environment Protection Act which makes environmental clearance and compliance legally binding with penalty provisions. This does not happen under the municipal act automatically; state building bye-laws are not uniformly stringent and binding across all states. Even though the National Building Code (NBC) is adding a chapter on 'Approach to sustainability', most of its requirements are voluntary and not legally binding. This can create serious loopholes if the EIA requirement is dismantled all of a sudden without adequate preparedness and legal provisions at the local level. An alternative system under the municipal act will have to be put in place before that. The new system will require complete revamp of the municipal laws and building bye-laws as well as NBC to incorporate sustainability concerns in addition to those of safety and comfort.

A lot of hard work is needed to build the technical capacity of urban local bodies to handle advanced and technically complex green building regulations and enforcement systems and integrate sustainability assessments with the normal building approval process. This is already evident from the ongoing efforts to get urban local bodies to implement the complex energy conservation building code for large commercial buildings. But even this code is a minimum requirement for all commercial buildings with a certain energy load. But the large and high-end buildings that require EIA will need to go much beyond the minimum requirement to perform better and reduce their energy footprints. Therefore, significant reforms are needed in the functioning and skill building of urban local bodies.

Current building approval processes have not been able to ensure structural safety or stop the violation of development norms. The recent spate of house collpases in India point to a serious need for reforms

Municipal reforms in all states are essential if the alternative model of EIA has to be integrated with the municipal clearance process. Just as the current EIA committee-based clearance system has fallen under disrepute for corrupt practices, the confidence in municipal agencies has also taken a hard hit after a series of building collapse episodes in the country. This exposes violation of minimum mandatory safety requirements under the municipal bye-laws. The fact that the current building approval process has not been able to ensure structural safety or stop the violation of development norms shows a lot of reforms are needed in the system to handle complex issues related to green building clearances. The age-old system of a building clearance process at municipal level will not suffice. Additional filters are needed for more holistic appraisal of high-end large buildings for environment impact assessment.

In any case, EIA clearance, as it is designed today, needs better integration with the municipal process, and city-based regulations for sustainability measures including rainwater harvesting, wastewater treatment and reuse, waste management, and energy efficiency. City-level reforms are taking shape to push these measures, though there is still a lot of departmental fragmentation of this mandate. Implementation agencies in cities will require a strong regulatory capacity and oversight and management of these systems.

The current framework of environmental clearance for buildings must go beyond consultant-driven project proposals and be backed by harmonised action with the designated authorities that are competent to assess energy, water, waste

AGNIMIRH BASU / CSE

Technical committees for environmental clearance need their own checklist of benchmarks to assess adequacy of conservation and efficiency measures to approve projects. Some local administrations (such as that of Delhi) have instituted checklists to assess energy efficiency of buildings

and traffic impacts of the projects and the adequacy of conservation techniques. The technical committees for environmental clearance also need their own checklist of benchmarks to assess adequacy of the conservation and efficiency measures to approve projects. For instance, in Delhi, the committee has developed its own checklist of parameters to assess energy efficiency of buildings. This includes mandatory orientation requirements, depth of the building for light to penetrate adequately, shading techniques, cool roofs, etc. This will have to be dovetailed for compliance with the Energy Conservation Building Code (ECBC) and the energy performance target.

It will require designated bodies with the skills and expertise to assess the claims of proponents. For instance, the technical committee for environment clearance does not have the expertise to assess the groundwater status of a site, traffic impacts of projects, status of compliance with energy code for buildings etc. A lot of these fall within the jurisdiction of urban local bodies, groundwater boards and urban development authorities.

If urban local bodies become the chosen agencies to integrate environmental clearance of large projects, a time-bound capacity building programme as well as adequate authority and legal back-up will be needed to ensure compliance, liability and penalty for defaulters.

TOWNSHIPS AND ENVIRONMENTAL CLEARANCE

The resource impacts of buildings cannot be reduced in isolation but in relation to urban design. All township projects need environmental clearance. This demands very strong linkages with the master plans under the Town and Country Planning Act. Increasingly, a smart city is becoming a part of common parlance in policy documents with no clear definition of what it stands for. The intent seems to be bordering around technical fixes and infrastructure development. But this is

happening without first defining the principles for sustainable urban design, density patterns and land use principles to guide the investments. All new townships, urban expansion and redevelopment require a master plan to integrate land use and transportation planning, mixed land use and mixed use neighbourhood planning, small block sizes, disincentives for gated communities, and a right balance of affordable housing and accessible streets and public transport. Though private green rating systems are emerging for townships, this requires regulatory standards and guidelines with an implementation strategy.

The traditional urban form was more compact and closely built, as it was designed on a human scale. Cities had to be made walkable to minimise distances. Closely spaced buildings shaded each other and the building designs were climate-sensitive. But the newer sprawl is aided by the car that decides the distance that can be traveled.

New townships need to integrate land use and transportation planning, mixed land use and mixed use neighbourhood planning, small block sizes, a right balance of affordable housing and accessible streets and public transport

Globally, urban design policies are bringing back many principles that governed the older and compact urban forms. California, which has otherwise witnessed massive sprawl because of car-centric development, is now reversing policies to promote compact city designs, and reduce energy intensity of new development to meet climate goals. The SB375 law of California requires jobs, recreation and housing planned in a way that people can live and work closer together, and drive less. The developers are accountable for this.

Policies have begun to take shape even in India. The National Habitat Standards of the Union ministry of urban development have laid down the guidelines for compact city design. The guidelines on compact mixed land use states, for example, that 95 per cent of residences should have daily needs retail, parks, primary schools and recreational areas accessible within 400 m walking distance. Also, 95 per cent of residences should have access to employment and public and institutional services by public transport/bicycle/walk, or a combination of two or more. At least 85 per cent of all streets should have mixed use development. The guidelines also emphasise on the need for small block sizes with high-density, permeable streets.

At the city level, Delhi is taking the lead in framing transit-oriented development policies. These policies are providing for a variety of mixed use, mixed income housing, employment and recreation options within walking/cycling distance and improved public transport accessibility. These policies are expected to incentivise high-density development for optimal use of urban space and resource efficiency. These policies are aiming to link the floor area ratio (FAR) threshold with a minimum density requirement.

A dangerous trend that is setting in, however, is the obsession with increasing the FAR without first defining the density requirements, urban design norms and accessibility conditions. Higher FAR is being used indiscriminately to lure the real estate industry. But just a higher FAR – that allows more spaces to be built – does not automatically result in densification, as provision of large-sized units defeats the purpose of densification. The maximum permissible FAR and densities are to be based on the capacity of public transport, circulation network and the physical infrastructure thresholds of the area. Often, it is also misinterpreted to justify very high rise buildings. This will require location-wise assessment. Optimal spacing needs to be designed between buildings allowing daylight and airflow through public areas and houses and thus, improve liveability. Mass construction of

buildings in housing and institutional complexes would also need to define the basic orientation requirements for maximum daylight use.

These norms and guidelines will have to be notified for the entire municipal/city area and new development areas and be made conditional and legally binding on private investments and for environmental clearance. These should be part of the master plans that are notified under the Town and Country Planning Act. Also, a lot of new construction will happen outside the municipal limits. Therefore, separate entities with strong technical skills and regulatory authority need to be designated for clearances.

Unsustainable urban design that includes gated communities with super blocks, vehicle-centric infrastructure, lack of localised resource conservation techniques, and waste management have the risk of locking in enormous carbon,

SAKSHI CHADDA DASGUPTA / CSE

Gated communities with car-centric infrastructure are becoming the bane of urban growth in India. A view of one such development in Kolkata

energy and pollution and need to be actively discouraged. These urban forms are taking shape very rapidly in new townships or in suburbs like Gurgaon near Delhi. A quick review has shown that in several cases, the developers do not meet the standards for social and physical infrastructure. As the developers delay obtaining their completion certificate, violation of key provisions goes unchecked. Transparency needs to be built to ensure that buyers of the housing units are in complete knowledge of the services and conditions pledged by the developers to the local government.

This brings out the importance of the interface of the building and the larger urban design to plan for sustainability. Overall, environment impact assessment measures and their implementation need reforms and stringent enforcement and a capacity to monitor performance during the operational phase. The instruments of penalty, incentives and resource pricing along with audits can also play an important role in reducing the environmental impacts of new development.

BUILDINGS AND ENERGY EFFICIENCY

Globally, energy concerns have catalysed the green building movement. It is now accepted that buildings can be designed, constructed and operated in a way that can lead to substantial energy savings. But translating this into a regulatory and implementation framework presents a technically complex challenge in India.

Under the mandate of the Energy Conservation Act of 2001, the BEE has crafted the ECBC which defines norms for various aspects of a building – walls, roofs, lighting, heating, ventilation, air-conditioning and other motors and equipments used in building operation and maintenance. The voluntary code is meant for thermal management and efficient lighting to reduce energy use. It is aimed at commercial buildings with a minimum connected load of 100 KW or contract demand of 120 KVA. Project proponents are expected to follow the norms set by the code and demonstrate compliance for approval. In addition to this, the BEE has also introduced star labeling for building operations and electrical appliances to reduce operational energy. Star rating grades buildings and appliances according to energy efficiency to encourage quicker uptake of energy-efficient solutions.

The ECBC defines norms for various aspects of a building: walls, roofs, lighting, heating, ventilation, air-conditioning and other motors and equipments used in building operation and maintenance

It is still not clear when the code will become mandatory. According to BEE, this demands adequate institutional, technical and enforcement capacity in cities. It is not yet clear how quickly such capacity can be scaled up in the states. Presently, some states have notified it, but its implementation is extremely limited.

However, even in this nascent stage of its implementation, several gaps have been noticed in the code. This has raised larger issues of principles that should guide energy regulations and codes for buildings and how ECBC can be linked with them for the desired policy outcomes. When the ECBC was crafted, there was very limited experience and expertise in India. A lot of it was patterned along the lines of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards for built environments. Now, there is a much deeper insight into India's unique challenges, advantages and opportunities. The code will have to be optimised to reflect them.

REFORM THE ECBC

The BEE has initiated a formal process to review the ECBC code. This is an opportunity to fix the code in a way that it delivers effectively on its intended objectives. It also offers a chance to examine the supportive policy measures that are needed for targeted improvement in building performance and energy savings in the sector as a whole. As this is a very new area of governance, periodic revision of the code is needed to respond to the newer learnings.

How does the ECBC work? There are two key approaches to comply with ECBC – prescriptive approach and a whole building performance (WBP) approach. In the prescriptive approach, the project proponent is expected to meet the norms prescribed for each aspect of the building (such as walls and roofs etc). But this gives no sense of the overall energy performance of the building. The WBP method is more appropriate to help buildings set overall energy performance targets in terms of EPI when they are being designed. This has all the mandatory norms common to prescriptive approach, but also provides scope for using architectural interventions to demonstrate improvements in the energy performance of the

building and reduction in energy intensity.

The ECBC is essentially a tool to set energy efficiency standards for appliances and equipments used in building operations and maintenance. The code also influences building design by prescribing standards for components of building envelope design and its thermal performance that have a direct impact on the energy efficiency of heating, ventilation, and air-conditioning (HVAC) systems. The code, therefore, ensures that the insulation for walls, roofs and glass follows performance standards and air leakages are stopped to ensure reduced cooling load on the HVAC system.

This code is meant only for fully air-conditioned buildings. But even in this, there are gaps and considerable scope for improvement. This demands review and remedy before its implementation becomes widespread. Once ECBC is adopted by the state governments, it becomes a state law to be enforced through local bye-laws. Any further delay in revision of the code can make subsequent state-level revision cumbersome and time-consuming.

There are several critical gaps in ECBC that can increase energy intensity of the building sector

There are several critical gaps in the ECBC that can increase energy intensity of the building sector. For instance, ECBC does not cap the thermostat or temperature setting for designing of the HVAC systems based on Indian climatic and comfort conditions. This is a critical parameter, as with a drop of one degree temperature from its setting the energy penalty can be as high as 3-10 per cent depending on the conditions. Global best practices show that for most building typologies, temperature setting is mandated at 27-28°C plus/minus one, taking into account the adaptive comfort conditions. Countries in Asia such as Japan, Sri Lanka, South Korea etc have set the thermostat for the HVAC system. Test results by the Tokyo Electric Power Company indicate that raising the AC's thermostat from 26°C to 28°C and using an electric fan in combination can reduce electricity consumption by up to 22 per cent. Only special buildings like hospitals or labs can have lower settings taking into account special needs of preventing infection etc.

The most controversial is the use of glass that is permitted in the building envelop under the code. The use of glass that is expressed as window-to-wall ratio (WWR) is capped at 60 per cent in prescriptive method of the code. But for the whole building performance method, it amounts to nearly uncontrolled use and can be much more than 60 per cent. This legal sanction for such high usage of glazing seems illogical when the standard use of glass in existing Indian buildings is 15-25 per cent. There is now a growing articulation of demand for lowering the limit to 40 per cent as this is the optimum WWR for Indian climatic conditions (except the cold regions); this can maximise energy savings through daylighting without adversely increasing the cooling load of the building.

The ECBC user guide explains that heat transfer through fenestration (windows and openings) is similar to the heat gain via walls and roofs through convection and conduction. Direct solar radiation contributes to heat gain through fenestration; hence, more fenestration area will naturally aid in heat gain in a tropical country like India. Any building with extensive glazing works like a greenhouse and traps heat inside the building. This enhances pressure on the HVAC system and increases energy consumption. Glass leads to unacceptable heat ingress and glare in all climatic zones of India, except the cold region. This warms up the interior requiring more severe air-conditioning. Internally, blinds

are put up to put out the glare and this increases the use of artificial light. Structural glass is also unsafe, especially during fires. Glass has high embodied energy as well. Often, industry claims that the glass being used is recyclable and therefore environment-friendly, but glass recycling is highly energy-intensive. Glass requires strategic use.

Ideally, one would expect the code to provide enough scope for using shading techniques adequately to reduce the heat gain from the envelop, including opaque walls and fenestration such as *chajja*s, louvers, sun breakers etc to reduce the heat load and to improve the energy performance. But use of such techniques is not mandated or prescribed in envelop section. The code only tacitly acknowledges the importance of shading by giving an exception under clause 4.3.3 that allows the building to have more solar heat gain co-efficient, amount of heat gain through windows, if the windows are shaded properly (it means that if the glass is shaded, there can be relaxation in the minimum efficiency norm for that glass, as the glass will not be exposed to sunlight and thus will automatically transmit less heat to the inside of the building). In such cases, the relaxation varies according to positioning, size and direction of the shading devices.

It is basic wisdom that glass traps heat and if not used strategically, it can increase the heat load despite the use of high performance glass in tropical climate

Heat gain will also depend on the orientation of the building. For example, the northern side receives much less sun than the other sides. But use of glazing has not been prescribed according to the orientation. A blanket relaxation of up to 60 per cent WWR (100 per cent under the WBP method) for all directions defies conventional wisdom as it will bring too much heat from the west and the south.

According to the norms of glazing, buildings need more tinted glazing to reduce light transmittance inside. While this may be needed for the building interiors, this raises concerns about the effect on the exterior and the heat island effect because of higher reflectance of heat. Clearly, a holistic approach is missing.

Making buildings such extensive and captive users of glass can undermine their energy saving potential. Such high use of high performance glass is not the answer. The glass industry is, of course, upbeat about this and some of the major glass producers like Saint Gobain have campaigned on 'glass is green'. But it is a basic wisdom that glass traps heat and if not used strategically according to orientation, it can increase the heat load despite the use of high performance glasses in tropical climate. On a life cycle basis, glass production is more energy-intensive and tinted glasses are not easily recyclable. ECBC will have to address these concerns over high use of glazing.

There is yet another concern over the current exemption given to on-site renewable energy generation getting accounted for in the overall building energy use. Under the WBP method, this can otherwise mask energy inefficiency. Buildings should adhere to the basic efficiency threshold before claiming benefits of their onsite renewable energy generation systems. The practice of hiding inefficient building by installing renewables cannot be encouraged, as these seriously compromise the overall energy sufficiency of the nation. The Energy Conservation Act of 2001 defines ECBC as the norms and standards of energy consumption expressed in terms of per sq m of the area wherein energy is used and includes the location of the building – whereas "energy" means any form of energy derived from fossil fuels, nuclear substances or materials, hydro-electricity and electricity generated from renewable sources of energy or biomass connected

to the grid. Thus, the Act clearly says that buildings have to be accountable for all the electricity purchased and generated.

Currently, the code is limited in its jurisdiction: it applies only to large-scale commercial projects. There are major savings to be made in the residential sector. Other countries are expanding the ambit of energy conservation to include the residential sector; in India, only the state of Punjab has followed suit. Moreover, considerable focus is also needed on retrofitting existing buildings.

NEED ENERGY PERFORMANCE AND SAVINGS TARGETS

What is ECBC trying to achieve? There is no clarity today about the current national baseline for energy performance in the building sector to understand how targets for future energy savings can be set and achieved. Traditional frugal lifestyle and poverty has influenced the energy efficiency baseline in India so far. But this baseline will change rapidly due to the rise of the middle class, changing aspirations and modified expectations of comfort. This can change the way buildings are designed and operated quite dramatically with huge energy penalties. But the ministry of power and the BEE have not set any energy savings goals for the sector to guide the use of the code. The BEE has not set any overall energy saving targets for the sector to be met in a time-bound manner.

BEE estimates that nationwide implementation of ECBC can yield savings of 1.7 billion kWh. But this does not indicate how the code can help the sector meet specific saving and performance targets

ECBC, therefore, works in isolation from any such additional and overall energy saving and energy performance targets for the sector. It is not possible to verify and quantify improvements in energy performance of the new building stock over time to reach a stated performance target. The code, therefore, works on the assumption that the new stock could have been far worse in energy performance because of increased dependence on mechanical cooling and other comfort requirements; but by making them adopt energy-efficient technologies their individual baselines can be improved. Based on this principle, the BEE estimates that nationwide implementation of ECBC can yield savings of 1.7 billion kWh. But this does not indicate how the code can help push the average performance of the sector to meet specific saving and performance targets.

For instance, the BEE has so far given a very broad approximation of the current national average baseline of energy performance index (EPI) for standard commercial buildings to indicate the extent of energy use in the building stock. The baseline EPI is about 180-200. The ECBC user guide estimates that an ECBC-compliant building will use 40-60 per cent less energy than conventional buildings; the BEE claims that with ECBC compliance, the EPI can improve to 110-140. But these estimates are not backed by any primary survey or detailed impact assessment.

There is a strong concern that the overall baseline can worsen as there are no additional policies to incentivise reduction in air-conditioned spaces or need for mechanical cooling, the single most crucial parameter that will influence energy intensity of buildings. Two out of five sections of the ECBC code, the way it is designed, work only for buildings that are suitable to be fully air-conditioned; but they are applicable to all buildings having a connected load of 100 kW or more irrespective of their air-conditioning status. The code assumes all future commercial buildings will be 100 per cent air-conditioned. It, therefore, aims to ensure rapid uptake of energy-efficient cooling and insulation systems and energy-efficient appliances to cut additional energy guzzling.

ECBC MAKES BUILDINGS CAPTIVE USERS OF AC

ECBC is designed for only fully air-conditioned buildings to ensure effective norms are followed to make the system and equipment energy-efficient. Therefore, in high performance air-conditioned buildings, the role of insulation becomes important: poorly insulated buildings can severely affect the efficiency of air-conditioning units and cause very high energy losses. Thus, ECBC has fixed the high insulating capability norm to ensure a rapid uptake of high performance insulating material in air-conditioned buildings. The market is thriving now on a wide variety of insulation materials – mineral wool, rock wool, vermiculite, foams, expanded polystyrene, extruded polystyrene etc.

But there is no option for an ECBC-compliant building to plan a non-air-conditioned space to reduce its energy imprints. For instance, any building or campus that uses 100 KW electricity qualifies for ECBC compliance. A large number of non-air-conditioned buildings or building complexes commercial in nature (like schools and colleges) will have connected loads higher than 100 KW and will fall under the ambit of ECBC. Even if they plan to keep some parts or building components non-air-conditioned, technically for compliance, they will still have to follow the requirements of insulation and building envelop according to the norms for AC buildings as prescribed by the code.

A non-AC space will also require high thermal performance for its envelope design. But the parameters are different for this kind of space. For instance, thermal mass (ability to store heat) of the walling material is of no importance in air-conditioned buildings, but plays a very important role in maintaining thermal comfort in non-AC space. Similarly, air leakages are a negative for air-conditioned buildings. But thermal comfort in non-AC spaces is based on ventilation which technically is air leakages from the building envelope. Imposing of ECBC norms for building envelope and ventilation on non-AC buildings will drastically compromise their energy prudency and comfort. Thus, buildings become captive users of air-conditioning by design.

Imposing of ECBC norms for building envelope and ventilation on non-AC buildings will drastically compromise their energy prudency and comfort

The code does not mention that unconditioned habitable spaces in the building envelop requires different designs and specifications to make them thermally and visually comfortable compared to a conditioned space. It makes an exception only for warehouses and storage spaces. The overall implication is that it has no scope of incentivising a reduction on conditioned spaces. Thus, the overall EPI can continue to get worse than the current baseline as the code will only ensure the building to be better than worse.

Moreover, as there is no supportive policy to set an overall energy performance target for the sector and link the code with it, there is less incentive for the real estate industry to optimise strategies to reduce air-conditioned spaces in buildings for more effective savings. This creates a risk of allowing the market to shift towards fully air-conditioned building stock with higher energy intensity and then use efficient technologies for some energy savings over a baseline that is continuously locking up more and more energy by design.

In the prescriptive approach of the code, for instance, the developer will follow efficiency norms for the technologies for cooling, insulation and lighting but will not be able to quantify and predict how much electricity the proposed building will consume per sq m a year. Thus, there is no method to verify if the operator actually saves money on energy savings. It is a blind date. Nor will the implementing

BIOME ENVIRONMENTAL SOLUTIONS PVT LTD, BENGALURU

Aesthetics of the green: The living room of architect Chitra Vishwanath's residence in Bengaluru is a poetry in natural light and ventilation and alternative building materials, particularly compressed stabilised earth blocks

agencies have a reference to crosscheck the performance according to design targets during the operation of the building. In the prescriptive approach, it is not easy to tell how the design translates into actual overall energy performance of the building. These air-conditioned buildings can have high energy intensity but will be compliant with ECBC by virtue of using technologies that meet the norms.

On the other hand, the WBP approach has the opportunity to use a range of architectural features like orientation, shading and ventilation to improve thermal comfort of the building. Does this mean it offers the opportunity to reduce air-conditioning in several parts of the building as well? Not really, as in practice there is no scope in design of using natural ventilation methods – letting fresh air come in through passive architectural design, needed to cool non-AC spaces. The ECBC guide states: "Buildings with no HVAC system cannot use WBP." ECBC has no scope of using natural ventilation as part of the compliance process. The provision on natural ventilation has been included in the HVAC section of the ECBC. It states that "...natural ventilation shall comply with the design guidelines provided for natural ventilation in the National Building Code 2005, part 8." But at the same time, the user guide is skeptical of this provision. It states that "these guidelines from NBC 2005 have been reproduced, keeping in view the philosophy behind this guide to keep ECBC reference material in the guide. However, the exact relevance of these general guidelines to the commercial buildings needs to be critically examined."

The ECBC user guide of BEE notes: "The WBP method is based on the assumption that non-residential buildings are both heated and cooled. Even if not installed initially, it is common for buildings lacking a heating or cooling system to have one retrofitted by future occupants." The user guide further states: "No shading projections are to be modeled, fenestration shall be assumed to be flush

with the exterior wall or roof." This section kills the possibility of using architectural interventions to demonstrate energy efficiency. It is to be further noted that buildings with no or limited HVAC systems will be the ones which will mostly rely on this method to prove their energy efficiency. In the prescriptive system, there is no scope of designing any part of the building differently and without the provision of air-conditioning. This means the building will have to follow high performance insulation requirement even in spaces not meant to be air-conditioned and this can compromise thermal comfort of that space. Thus, the design requirement of ECBC by default mandates fully air-conditioned building.

But in a country like India with diverse climatic zones that offer enormous advantage of minimising the use of ACs at several times of the day and also several parts of the year, no thought has gone into creating supportive policies to leverage the advantages and incentivise passive architectural interventions to reduce energy footprints of buildings. This assumption of 100 per cent air-conditioned commercial buildings is a misnomer – McKinsey has projected that about 60 per cent of the new building stock is expected to be fully air-conditioned by 2030.

If such additional policy measures are not adopted to promote passive cooling architecture and appropriate material, the average baseline for energy efficiency in the sector will go haywire. There is a reason for this concern. A mechanically cooled building even after meeting the minimum norms of BEE can have high energy intensity. If too many of them are built, it will worsen the average for the sector. For instance, the BEE has developed an online ECOnirman tool that allows architects and engineers to assess how their designs measure up to ECBC. This crosschecks all the 104 mandatory parameters of the code along with the multiple prescriptive parameters. Based on several hypothetical models generated by CSE using this tool, it was found that the EPI of an ECBC-compliant building could range between 170-400. This compares poorly with the BEE stated average EPI of a standard building, which is 180-200.

If additional policy measures are not adopted to promote passive cooling architecture and appropriate material, the average baseline for energy efficiency in the sector will go haywire

This only re-emphasises the importance of having supportive regulations to create incentives for passive architectural approaches and alternative material to improve thermal comfort of buildings. Ideally, regulations should set EPI-based targets for designing for construction.

This can open up opportunities for passive architecture, to innovatively use orientation, daylight and ventilation to minimise dependence on mechanical cooling and ensure enormous energy savings. Wise architectural design lets in good glare-free daylight to reduce lighting requirements, and prevents overheating through exposed glasses and surfaces. By changing the orientation of buildings and by using a wide variety of shading, they can cut the heat and glare. A range of innovative cooling, insulation and ventilation techniques can save energy.

Architects are already working with a variety of ways to reduce solar heat gain using innovative designs – like filler slabs, double roofs, cavity/filler walls, composite walls, shading etc. They are using many methods and materials – replacing conventional building materials like brick and concrete with autoclaved aerated concrete blocks, hollow blocks, thermocrete or other building materials with inherent higher R-values that can also improve buildings' insulation. Without regulatory incentives, the innovation in sustainable materials like bamboo or rammed earth can be stymied as otherwise these cannot meet the insulation values needed under the code for fully air-conditioned buildings. India is in the forefront

of this innovation, but there is no regulatory support for this.

Building gurus try to lower damage to the environment through locally-obtained woods and stone and responsibly-harvested woods. They select material with low embedded energy. For example, stabilised earth blocks, straw bales, stones, sandstone chips and flyash have much lower energy intensity (less than 0.5 Giga Joules per tonne) than glass, aluminum, stainless steel, copper, zinc, cement or ready mix concrete (more than 5 Giga Joules per tonne).

Green building regulations need to provide opportunities for a range of passive building designs, locally appropriate materials, orientation and shading principles to improve the energy efficiency performance of the buildings. They need to be climate-sensitive as climatic conditions – temperate, warm and humid, composite and hot and dry – govern the choice of material and design. There are no simple magic bullets. Green building policies need to promote inventiveness and a bouquet of interventions.

SPRUCE UP THE IMPLEMENTATION STRATEGY

While it is important to fix the code and related policies for better impacts, institutional framework and regulatory capacity will have to be spruced up in cities for enforcement. Policies cannot deliver if performance monitoring of buildings remains weak. Buildings can seriously underperform without detection. Most green building policies and ratings are being implemented without any clear effort to monitor building performance.

Policies cannot deliver if performance monitoring of buildings remains weak. Buildings can seriously under-perform

Even though ECBC has been around since 2007 it has not been implemented effectively on ground yet. State governments have initiated the administrative process for its implementation. Some have even notified and amended it to suit local conditions. But the implementing agencies have not yet developed adequate technical capacity to implement ECBC at a scale needed to make a difference.

The BEE is helping promote web-based tools for compliance checks; checklists of interventions necessary for compliance; and rules to support enforcement. This will require immense capacity building in urban local bodies. This will also require a strong cadre of independent ECBC-certified professionals for verification of design, construction and completion of buildings. States are planning demonstration projects to guide implementation. Cities will also need to map out the availability of energy-efficient material to support implementation.

Several state governments have already notified ECBC to begin implementation. These include Rajasthan, Punjab, Haryana and Odisha, among others. Several of them are also taking steps to modify the ECBC to customise for local conditions and requirements. Punjab has gone ahead to bring large residential sectors within its zone. Rajasthan has included an additional clause that says that buildings with less than 1,000 sq m of air-conditioned space will not require ECBC.

The state-level action is also an opportunity to fix the gaps that have been noted in the code, as well as locate this within a larger energy policy for the sector that will set the terms for action. The implementation of ECBC and its reform will also require harmonisation of the code with several other rules, bye-laws and regulations related to safety and environmental impacts of the building sector. ECBC must be harmonised with other regulatory tools in place for implementing energy regulations, like the National Building Code, EIA and the green rating tools.

Harmonisation of ECBC with NBC has already been carried out by including a chapter on "Approach to sustainability" which would be adopted in all future constructions in the country. States need more comprehensive energy regulations for the building sector.

ADDRESS OPERATIONAL ENERGY

While the ECBC code is expected to influence the design and construction of buildings for quicker uptake of energy-efficient buildings, the BEE has additionally introduced star rating of buildings to influence and curb energy use. Buildings are star rated according to the bandwidth of the energy use – the most efficient band gets the 5-star rank. However, there is scope for further improvement in the star rating process. For instance, the BEE needs to stop discriminating between buildings based on air-conditioned area and set common but stringent standards. Operational energy is a critical parameter that ultimately decides the actual energy savings in the building. It is important to develop some synergistic relationships between the designed EPI and the expected performance of the building.

City governments now need additional policies to influence behaviour to curb energy use. Consumption-based energy pricing and billing can make a difference. Global studies show that when tenants are billed for actual consumption, energy use for heating typically drops by 10 to 20 per cent. Otherwise, the growing trend towards multiple ownership of efficient appliances like refrigerators will lead to use of more energy. Often, retailers increase the lighting use even after meeting specifications. As a result, total energy use increases. A study by the WBCD shows that people may increase usage after installing efficient lights but lose up to 12 per cent of the expected energy savings by leaving them on longer. An efficient furnace loses up to 30 per cent because people raise the thermostat. Energy policies for the building sector in cities require a range of energy indicators – absolute total usage; per person per year; and per square meter per year need to be tracked as part of the regulatory programme for real results. The US government's energy star rating for existing commercial buildings factors in the buildings' occupancy data in deciding their final energy efficiency scores.

Cities need additional policies to influence behaviour to curb energy consumption. Use-based energy pricing and billing can make a difference

ADDRESS ELECTRICAL APPLIANCE EFFICIENCY

The immediate manifestation of the rising middle class and commercial growth has been in the explosive increase in the use of electrical appliances – fans, lights, refrigerators, air-conditioners etc. The BEE has implemented a star labeling system for some of the key appliances to push the market towards energy-efficient equipment. But India requires a quicker revision of benchmarks for star labeling of electrical appliances for more effective energy savings. A majority of the manufacturers are multinationals and have the technology to produce products meeting much tighter norms in advanced markets. The BEE needs to push the Indian market towards super-efficient models with more ambitious targets to get the best available technology.

Recently, the norms for star labeling of air conditioning and refrigerators were revised. But even after the revision, a 5-star AC represents only a marginal improvement and is equivalent to a 2.5-star rating of Australia. The 5-star brands have become more expensive for only marginal energy savings.

Effective labeling will also require better testing methods to approximate real-

time performance. Designing and testing of appliances at temperatures close to the conditions when they will most likely be used offers the widest range of engineering and design options for AC manufacturers. Overall, the testing conditions need to reflect the actual use conditions of all appliances – either at full load or part load. This requires improvement in testing for labeling. Also, the new super-efficient equipment programme should be phased in for all appliances for significant energy savings.

It is, therefore, clear that with growing aspirations and demand for resource-intensive lifestyles, regulations will have to be stepped up to reduce energy intensity of built areas, as well as manage demand and aspiration with market-based instruments and efficiency measures. At the early stages of growth, India will have to take steps to find innovative and creative architectural pathways to optimise use of climatic advantages of different zones, minimise use of artificial cooling and heating of built environment, and reduce demand for energy-intensive technologies.

THE DILEMMA OF GREEN RATING

Rating is a quicker way of absorbing resource saving techniques that can also support regulations and standard development

To encourage more spontaneous and comprehensive greening of the building sector, private and voluntary initiatives have evolved to rate buildings based on well established criteria for resource savings and waste minimisation. These are voluntary and market-based schemes that rate environmental performance of buildings. The corporate sector often responds well to these schemes as these have a reputational advantage, fit in with corporate social responsibility and contribute towards green image engineering.

Another advantage of the rating system is that green building requires a complex set of criteria and indicators for a wide range of resources – energy, water, land, air, biodiversity etc. These cannot be packaged as a single regulation, but can be promoted through a rating system. This is a quicker way of absorbing resource saving techniques that can also support regulations and standard development.

India has two matured rating programmes: the LEED-India Programme was adapted from the United States Green Building Council's LEED (Leadership in Energy and Environmental Design) in 2007. This was run by the Indian Green Building Council (IGBC) till June 2014. The other system is the Green Rating for Integrated Habitat Assessment (GRIHA), conceived and administered by The Energy and Resources Institute (TERI). GRIHA was adopted as the National Rating System (NRS) under the MNRE on November 1, 2007. It is a green building 'design evaluation system', and is deemed suitable for all kinds of buildings (except industrial buildings) in different climatic zones of the country.

The primary reason why private rating systems have now come under scrutiny is mainly because they are now getting linked with the promotional schemes of the government that include fiscal concessions and incentives of extra built-up areas. Several city governments are working out incentive packages to promote green rating for buildings. Noida in Uttar Pradesh and Pimpri-Chinchwad near Pune are in the forefront of these efforts. Government's involvement, official incentives and its implications for public finance demands transparency, accountability and stringent monitoring, with penalty for non-compliance. As part of the compliance strategy, some of the local governments (as in Noida) have designed a penalty

programme. But there is hardly any system to put the annual performance data of the rated buildings in the public domain for transparency and accountability and to assess their overall performance. Only very recently have IGBC and GRIHA begun to share some information publicly, but that is not adequate. There is no official system either for concerned departments to collate and put out the information on buildings that are enjoying any kind of government incentive.

Involvement of government and public money requires a legal framework to mandate transparent sharing of information on green features, costs and pay-back, and performance data of green rated buildings to verify claims on resource savings. This requires an uniform and standard online official directory of all the green rated and pre-certified building projects. A central directory of green registered, rated and ratified projects is necessary. There is a need for greater accountability and transparency in the building sector, including builders, developers, consultants, green rating agencies and government agencies. In fact, during the time when MNRE had extended its support to GRIHA the ministry did not maintain detail on the performance of the projects.

Rating should push only the top line and not duplicate what regulations need to enforce. A great part of the rating requirements are already and should be part of the buildings related regulations. It is unfair to give incentives to a few buildings for what all buildings should be doing as part of the regulations. The focus should be on mainstreaming of resource saving regulations and their implementation for wide coverage of buildings projects. Incentive for green rating should be linked only with super efficient benchmark, regular public disclosure on actual performance and annual audits.

Green rating should push only the top line and not duplicate what regulations need to enforce

Global experience with rating has shown, as in the US, that some of the LEED-rated buildings were under performing compared to standard building. This has led to reforms that require buildings to provide energy bills etc for proper monitoring of performance.

This also demands a deeper scrutiny of the type of incentives that the city governments are designing for the developers. There are serious concerns over the current practice of promising extra built up area in the form of extra floor area ratio (FAR) or floor space index (FSI). As the system of compliance and performance monitoring remains extremely weak and non existent any violation or weak enforcement can lock up enormous inefficiencies in the new built up areas. Allowing extra built up area with only penalty for non-compliance is beset with dangers of building enormous inefficiency as built environment cannot be easily reversed. Also, any FAR bonuses should be conjoined by other habitat development norms and transit-oriented development norms to minimise negative impacts on urban environment. Use fiscal incentives in the forms of soft loans, cash incentives, tax incentives, etc.

AFFORDABLE HOUSING FOR THE POOR

Green buildings are not only about reducing resource impacts of homes and offices of the rich. These are also about improving comfort level and liveability of the poor peoples' homes. The informal economy is an integral part of the overall urban economy and growth that will always require substantial provision of low cost housing. But this presents a special design challenge given the unique requirements

AVIKAL SOMVANSHI / CSE

A mason works on a self-constructed house. As there is enormous deficit in housing stock for the poor, people have no other option but to build settlements in vacant public land close to their sources of livelihood

of these households. The housing and habitat policy will have to respond to that.

This challenge is big. As there is enormous deficit in housing stock for the poor, people have no other option but to build settlements in vacant public land close to their source of livelihood. While some colonies are given legal recognition others remain illegal. These so called 'illegal' settlements remain outside the orbit of municipal governance and service provisioning. This adversely affects the quality of life and health of urban poor. Illegality also bars them from accessing formal housing finance and blocks enforcement of basic safety standards for buildings. The deficit is also leading to homelessness, congested living in informal settlements. An estimate from Mumbai-based Institute of Urbanology shows that between 1997 and 2002, the government and builders built 500,000 houses in urban India; but during the same time, people built 8.5 million units in informal settlements or as the Institute of Urbanology terms it, 'homegrown settlements'.

Clearly, regulations will have to respond adequately to two typologies: formal affordable housing and self-constructed houses of the poor in informal settlements.

Overall, national and state policies, programmes and schemes are evolving for the affordable housing sector. These are expected to facilitate affordable housing stock, provide capital grants support to affordable housing projects; design financial incentives; accord industry status to the real estate industry; consider viability gap funding for affordable housing projects; facilitate greater flow of capital through external commercial borrowings and FDI; new financing from insurance and pension funds; and promote credit risk guarantee fund trust and urban housing fund. Moreover, the existing Master Plans and land use plans would need to ensure inclusive principles of planning and earmarking of zones/lands for the affordable housing projects. A lot of it is yet to take a real shape.

The state governments are framing several models of affordable housing policy to influence private investment in the sector. Policies are mandating a certain percentage of new building stock, at least 15 per cent of the total project FAR and FSI or 35 per cent of the total number of dwelling units for economically weaker sections; people-friendly land acquisition policies; trunk infrastructure facilities and transportation linkages to sites etc. There are talks of land banks and asset management plans for better management of the available land and integration of affordable housing. This will also require infrastructure services including water supply, sanitation, health, education facilities to existing housing colonies. *In situ* upgradation in informal settlements are being taken up through various schemes of Central and state governments.

The overall thrust of official action is on incentivising the private sector to provide affordable housing. But this requires strong enforcement, monitoring, and strategies

Builders and developers are being incentivised with additional FAR/FSI and Transfer of Development Rights (TDR) credits in their projects if they build exclusive affordable housing projects as prescribed. A rent act that balances the interests of both the tenant and the owner, and supporting exclusive rental accommodations/dormitories for workers from outside the city/region, is also on the table. There are proposals for financial incentives to private developers. Regulations related to FAR/FSI are being relaxed, ground coverage is to be increased, and parking requirements will be reduced to get more housing stock. In fact, the national guidelines are talking about setting a minimum density target of <350 dwelling units/ha, which is an additional 50 per cent density over and above what is otherwise required.

The overall thrust is on incentivising the private sector to provide affordable housing. But this requires strong enforcement, monitoring, and strategies to ensure quality and safe structure, appropriate design sensitive to unique needs of economic and community imperatives of the community. States need to come up with more detailed and stringent guidelines to address these concerns in the private sector.

However, the most neglected area is technical and financial support for the self-constructed houses of the poor. A lot more will have to be done to provide support and help to influence self-construction by the poor and low income households. Given the fact that much larger numbers of houses are being constructed by the poor themselves demands professional, technical, financial, and infrastructure support. This requires governmental intervention to create capacity and facilities to provide guidance on local styles and appropriate architecture and low cost material for construction of housing stock, innovative technology and building materials for low cost and mass housing, low energy consuming building material; common area facilities and utilities, space planning, rainwater harvesting and

water conservation technologies and waste treatment. Local skills and capacity will have to be mobilised and upgraded to support local construction.

India needs to tap the learning curve in several other countries where they have adopted strategies and policies to formalise community and professional support to help communities in the informal settlements to address the problem of land tenure and ownership, professional support for robust design and safe structures, making building bye-laws flexible to meet their requirements, and demarcate parcels of land in master plans or land pooling for affordable housing projects that may include formal housing, self construction and incremental provision of housing and financing schemes.

Even in India, several voluntary groups have come forward, as in Delhi and Mumbai, to work with those households who have taken up construction of homes in informal settlements to provide technical and architectural support for construction and renovation, use of material, help with finances and also upgrade local skills of masonry, and plumbing. But the explicit official policies are not available to enable professional groups to mobilise resources and provide professional and technical help to communities to design and build their own homes.

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Well laid out policies are needed to organise finances for construction of poor people's home. There are challenges of mortgage and leasehold property rights and land titles for the economically weaker sections and low income categories. Housing development banks and state governments are expected to promote linkages to formal lending institutions such as micro housing finance institutions and the beneficiaries. This will require immediate interventions to create an appropriate model.

WASTE AS RESOURCE

Buildings require enormous amount of virgin material that are sourced from the nature and this has significant impact on the environment. But construction, repair and maintenance of buildings also generate large amounts of building waste or construction and demolition (C&D) debris that have a devastating impact on the environment. This waste is a sum total of excavated soil, dredging spoils, sand, gravel, concrete, asphalt, wood, brick, metals, wallboard, and roofing shingles, etc. Their disposal and reuse has not yet been worked out well in Indian cities. Yet this waste is a resource and can be significantly minimised if regulations and infrastructure exist to ensure their reuse in the construction sector.

Without a good project management and legal framework for C&D waste management these debris find their way into waterbodies, green areas, low lying areas and cause serious damage. Though their quantum is expected to be very high there are no clear official estimates of the actual magnitude of this waste in India. Way back in 2001, Technology Information, Forecasting and Assessment Council (TIFAC) under the department of science and technology in its report on C&D waste stated that the quantum of solid waste generation in India is about 48 MT per annum, of which waste from the construction industry accounts for 25 per cent or 12-14.7 MT per annum. This estimate was taken on board by the Union ministry of urban development (MoUD). Oddly, this estimate has not changed in the official documents over the years though construction activities have increased rapidly in

the country. The same estimate finds a mention in the MoEF report of 2010.

There is no regulatory preparedness to track and recycle this waste. According to McKinsey & Co, new construction in India since 2005 amounts to 5.75 billion sq m of additional floor space, with almost 1 billion sq m in 2013 itself. If according to the thumb rule of TIFAC, a new construction generates 40-60 kg of C&D waste per sq m, then assuming an average of 50 kg per sq m, India must have generated 50 MT of C&D waste in 2013 alone and about 287 MT from new construction over the last eight years. This will continue to increase at the same rate as growth of real estate without regulations. The magnitude of this waste is expected to much bigger given the fact that according to the NSS' 65th Round results, only 47 per cent of houses in India are perceived to be in good condition; 10.7 per cent are classified as bad or not fit for habitation.

The bigger challenge today is to get the right regulatory framework for reuse and recycle of this waste and infrastructure for its collection and recycling.

Construction agencies are not warming up to the possibility of recycling and reusing C&D waste in the construction sector because National Building Code has not explicitly included any provision on recycling and the BIS has not developed standards for the recycled material. The construction industry perceives that the Indian standards allows only 'naturally sourced' building material like sand, aggregate that are mined directly from nature. Even though a small beginning has been made by setting up a recycling facility for C&D waste in Burari near Delhi, market uptake of the recycled products is still very limited.

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However, considerable policy discussion has taken place of late that has brought a lot of policy clarity. As part of the deliberations initiated by the Environment Pollution (Prevention and Control) Authority (EPCA), it has been pointed out by the officials of the BIS that it is not enough to consider the clause IS:383-1970 that is on natural material. Under IS:456-2000, the BIS permits use of aggregates other than natural aggregates in plain concrete. Therefore, any agency and authority can take the initiative and permit recycled material even if explicit standard for alternative or recycled material may come in due course. But this provision has not been utilised adequately as technically the absence of the word "recycled" in the text of the IS:456-2000 has created a roadblock.

Standard-setting for recycled material has got considerably delayed because this requires technical studies to back up the process. But research on suitability of recycled C&D waste as replacement for natural aggregate in concrete in India is sparse and very inadequate. There are a few technical studies under progress that have shown promise. NCCBM studies have established that fine aggregate from recycled C&D waste has better results and can be considered for replacement of natural fine aggregates. Year-long durability studies are still going on. The CBRI has done work on the quality of aggregate and established that this would depend on the quality of source. Ten beams were tested at CBRI, with 100 per cent replacement of aggregates by Recycled Concrete Aggregate (RCA) resulting in just 18 per cent increase in deflection. The Central Road Research Institute holds that these could be best utilised in road construction. Use of up to 20 per cent RCA in concrete as replacement of natural coarse aggregates, with appropriate precautions, is being considered.

The BIS has now formulated a panel for aggregates from other than natural sources to address the issue. This panel will look at various options of alternatives

to natural aggregates including blast furnace slag as coarse and fine aggregate; steel slag as coarse and fine aggregate; copper slag as fine aggregate; sintered flyash as coarse aggregate; and coarse and fine aggregates derived from C&D waste. Research and development is already in advanced stages in nation's premier institutes. These researches should be leveraged quickly to hasten the process. There is already a precedent in which recycling of flyash and its products have been allowed in the construction sector.

Moreover, it is also important to include explicit provisions on collection, disposal and reuse of C&D waste in the draft Municipal Solid Waste and Management Rules of 2013, or draft separate rules for this waste.

Cities need innovative schemes that allow new products, systems or techniques related to housing/building not covered so far by BIS, to be certified after detailed evaluation. Construction agencies or authorities may include a material in their schedule of rates if backed by a test study based on BIS criteria, even if the standards have not been developed. Alternative material can be adopted for non-structural use as an interim measure till the time standards are in place. The Central Public Works Department needs to revise its schedule of rates for material purchase to include products made out of recycled C&D waste. Such a move was made earlier to use flyash products.

Fiscal signals can have a strong impact on the market. Tax policies can be framed to minimise waste generation and prevent unsafe disposal

Fiscal signals can have a strong impact on the market. Tax policies can be framed to minimise waste generation and prevent unsafe disposal. In line with global best practices, it is possible to introduce taxation to incentivise waste minimisation. For instance, Hong Kong, which has serious land constraints and therefore cannot afford landfills, has very stringent controls over C&D waste. Hong Kong imposes a construction waste charge on developers. The system has lowered the quantity of C&D waste needing disposal at landfill by 60 per cent. Rates have been structured to incentivise on-site recycling and reuse; 100 per cent waste utilisation is charged at HK $27 (Rs 200) per tonne while more than 50 per cent waste needing landfill disposal is charged at HK $125 (Rs 1,000) per tonne. Revenue generated is used to maintain and subsidise C&D waste recycling centres. This has minimised generation of construction debris. Innovative application of alternative material will also require strong legal back-up and integration with the building approval process.

Given the magnitude of environmental destruction associated with construction material, promotion of alternatives and recycling of waste is not a matter of choice but necessity.

LET US DO OUR BIT

Green building is not a prescription. It is common sense that blends conventional wisdom with modern science. But to carry this mandate forward, one must deepen the understanding of the linkages between green buildings and sustainable lifestyles. Though people have widely different reasons for buying homes and offices, they do value indoor air quality, comfort levels and economic savings. The challenge is to link the green architectural features, design and material with health, happiness and quality of life that people can relate to. India already has a strong architectural tradition that has responded creatively to its unique and diverse climatic conditions and eco-systems. The *Vastu Shastra* has blended the

use of sun and wind with architectural flow and with liveability and well-being.

But modern building construction, and the myriad variety of material and technical interventions that are possible to control comfort conditions are getting more complex. There is very little public understanding of green building features, architectural interventions, materials and design. It is important to demystify green building measures and build public support and acceptance of new programmes.

The primary consumer is not always clear how resource efficiency in buildings works, and what it entails. People need to understand what 'works' and what 'doesn't' in terms of resource-saving strategies for homes. This needs to be demystified for quicker uptake of innovations and solutions. While a lot can be achieved in a cost-effective manner, the extra investment need not become a deterrent. People need information about the rate of return on costs for energy-efficient products and appliances. People must know where to find information on options, prices and suppliers, and also the architectural wisdom needed to reduce resource footprints. Deepening of this understanding is critical for an individual's decision to conserve resources and add to the overall savings that benefit the community.

Clearly, buildings cannot be treated as a low impact sector. While individually they exert a substantial impact on the surrounding environment, cumulatively and together they make significant impact on the overall urban environment. Despite being a major resource predator, the building construction sector is poorly regulated. This has to change.